Specialize rightly or decline

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Abstract

Is exporting potato chips really the same than exporting microchips for a country economic growth? Is the rate of economic growth independent on the production/export structure? Is moving toward dynamic sectors a key for economic growth? This paper exploits a panel dataset for 188 countries and almost 700 sectors over the 1960-2004 period. Our purpose is to determine if and how sectoral structure influences the rate of economic growth, both from a static and a dynamic perspective. Different theoretical lines of research give suggestion in this direction: both past keynesian contributions and the endogenous growth literature suggest that economic structure can play an effective role in influencing economic growth. Our empirical analysis, shows that there is some evidence of this kind. We test the robustness of our result, checking the sensitivity of our main result to several alternatives

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1 Introduction

In many people there is the idea that trade specialization of an economy may influence its rate of growth. The idea is that the specific specialization of an area (country) has to be relevant in determining its economic growth path: producing potato chips is not the same than producing micro-chips.

The theoretical literature on specialization and growth is divided into two main strands: demand-side and supply-side models. In both this kind of models countries have stable specialization structures, constant rates of growth, but these growth rates differ among countries, because they specialize in the production of different goods.

On the empirical side, and surprisingly enough, this issue has not been investigated in depth. Some systematic work has been developed only recently.

In this paper we develop an empirical strategy to test the above described relationship, defining some specialization indexes and using them as regressors in growth equations Our indexes, following a recent contribution to this literature, are comprehensive indexes, that is to say indexes that provide a full, even if synthetic, information on the model of specialization.

The following part of this paper is organized as follows: in section 2.1 we analyze theoretical models, while in section 2.2 previous empirical results are discussed. Then we propose, in section 3, a couple of static index of specialization and, successively, their dynamic versions. After two sections describing both the econometric strategy and the dataset employed in the analysis, section 6 shows our results. A final section concludes.

2 Summary of previous empirical works

2.1 Theory

There is an ongoing debate on the influence of trade specialization on an economy's rate of growth. The idea that the specific specialization of an area (country) has to be relevant in determining its economic growth path can be summarized according to the following sentence: "specializing in some products will bring higher growth than specializing in others" (Hausmann, Hwang, Rodrik, 2006).

The theoretical literature on specialization and growth is divided into two main strands: demand-side and supply-side models. The former are associated with "structuralism" à la Prebisch, which maintains that unequal trade restricts the development chances of the South, or with models in the

Keynesian tradition (Thirlwall, 1979), where growth is driven by the income elasticities of exports and imports and cumulative causation forces. Thirlwall final growth equation (Thirlwall's law) is:

$$\dot{y}/y = \frac{\epsilon(\dot{Y}/Y)}{\pi} \tag{1}$$

National growth $\dot{y}/y$ depends on world demand growth $\dot{Y}/Y$, given the export and import elasticities ϵ and π.

The idea behind this model is that "'if a country gets into balance-of-payments difficulties ... demand must be curtailed; supply is never fully utilised; investment is discuraged; technological progress is slowed down ... A vicious circle is started"' (McCombie and Thirlwall, 1994, p. 233). The same authors, explaining why should export and import elasticities differ among countruies, wrote that this "'this deeper question"' may be answered considering that those elasticities are "'primarily associated with the characteristics of goods produced"' (p. 244), i.e. with something that has to do with countries' models of specialization. It is evident that the two elasticities can be thought sufficiently stable exactly if they depend on something whose change is slow, as economic structure. The model of specialization is, at a very large extent, a structural characteristic of the economy of a country. So there is non much surprise in observing that many authors consider it substantially rigid. [1]

In the keynesian perspective, Fiorillo (2000) developed a model of coevolution of rates of growth and export structures. A first relevant point in his model has to do with the presence of a localized Verdoorn's law

$$\frac{\dot{\pi_n}}{\pi_n} = a_n + \lambda_n Q \tag{2}$$

where productivity (π_n) growth in sector n specifically depends on total production (Q) through a local parameter (λ_n). This could resemble endogenous growth theory equations (see below) on specific knowledge accumulation. Effectively it plays a similar role (growing efficiency with growth of produced goods), but it has a different interpretation, with a Smithian flavor: enlargement of the market engenders productivity growth through higher specialization.

More recently, the static theory of international trade has undergone interesting evolution with models of endogenous growth (Romer, 1986 and

[1] Curiously, the same economic regularities were explained using different "supply-side" approaches (Krugman, 1989) which emphasized the connection between growth and the elasticity of the components of foreign trade, on the one hand, and between these and the sectoral composition of production on the other.

1990; Grossman and Helpman, 1991, Lucas, 1988; Young, 1991) in which supply-side factors (and among them the specialization pattern) play a dominant role.

Lucas (1988) proposes a model with sector specific learning by doing processes. As a consequence, the pattern of specialization that emerge is necessarily stable. In Lucas' model two final goods are produced according to a ricardian production technology:

$$Q_n = h_n u_n L \tag{3}$$

where Q_n is production of good n, h_n per capita human capital specialized in the production of the same good, and u_n is the share of work force L employed in n. The key assumption of the model refers to the accumulation of h_n:

$$\dot{h}_n = h_n \delta_n u_n \tag{4}$$

From equation 4 h_n can be interpreted as the outcome of a learning-by-doing process: the growth of h_n depends on the effort u_n and learning-by-doing is supposed to be sector specific, as indicated by the parameter δ_n.

Then consider that, in an open economy, countries will specialize on the basis of comparative advantages. If countries differ in the distribution of the learning parameter δ_n their comparative advantages will be determined by differences in δ_n. In the Lucas example, rich countries will specialize in sectors with high learning-by-doing potentialities, and for this reason they will have higher rates of growth than LDCs (specialized in sectors with less intense learning-by-doing processes).

In the model countries have constant endogenously determined rate of growth, but growth rates differ among countries, because they specialize in the production of goods with different intensities of learning-by-doing. As Lucas himself discusses, the model predicts a very stable structure, originating by initial conditions and local feedbacks (and this is the same result, broadly speaking, of Thirlwall).

A similar approach is followed by Grossman and Helpman (1991). In a first model, they suppose that the stock of knowledge in any country is directly proportional to (equal, by choice of units) the number of differentiated goods produced locally: spillovers are solely national. In this case initial conditions clearly determine final outcomes in terms of trade structure and economic growth, and this sounds similar to the previous conclusions.

Nevertheless, in a second model, where knowledge is accumulated through production but there are perfect international spillovers, they predict that initial conditions are not relevant in determining comparative advantages (in the long run) or rates of innovation and economic growth: "history of (country) production structure plays no role in the explanation of its long-run trade pattern" (pag. 178).

This last sentence says that outcomes of the models can differ substantially on the basis of different hypothesis; no doubt that, as Grossman and Helpman themselves underline, in the real world we find more mixed and less neat situations, and outcome will be even less clearly identifiable.

In fact, in reality, the composition of demand and supply changes with the evolution of the economy, and, moreover, technical progress always introduces new goods and new production processes (and not simply new varieties).

Finally, it is possible to find, both in the Keynesian and in the endogenous growth traditions, some other models directly or indirectly remove the previous rigid hypothesis, especially introducing technical changes, spillovers and technology transfers among different countries and sectors. This kind of changes obviously allows a sensible mobility of the economic (and trade) structures.

As a first step in this "growing complexity" direction, look at the results of the already quoted Fiorillo's model. The author add a second key hypothesis: export elasticities positively depend on profits, in their turn an effect of productivity enhancement. Growth of export elasticities is a consequence of rising good quality, an effect of research efforts allowed by increased profits. The results of the paper are complex enough and can be summarized as follows: countries specialized in different sectors possibly follow different patterns of growth and export structure, but regimes of constant growth and export structures are followed by sudden changes in both of them, due to changes in the ranking of export elasticities, so that catching-up, forging ahead and falling behind are all possible outcomes, i.e.there is not a univoque relation between models of specialization and rates of growth of different economies.

A similar qualitative conclusion can be drawn again by Grossman and Helpman (1991) In a model of product cycles they "are interested in the nature of the feedbacks between innovation and imitation and the effects of North-South Trade on growth in each region". While world has a constant rate of growth, goods are initially invented in the North (successful Research and Development), and, successively, they can shift to to the South (successful imitation) or remain in the North (successful upgrade). In this context it is also possible that good productions move from South to North when "a standardized product becomes obsolete with the invention of a new generation of goods" (the so called dematurity) (p. 311).

As a consequence, even in the endogenous growth tradition, specialization is not detemined in a stable way and production of a specific good can shift from North to South and the opposite also several times, even if in the long run there are well defined rates of innovation and imitation. In synthesis, also in this case it is difficult to make neat deductions on the growth-specialization relationship.

A synthetic way to look at the previous discussion is to point out that theoretical literature seems to suggest that specialization can be a limit or a push for growth, and outcomes are especially clear only when localized scale economies are at work.

Nevertheless both innovation and imitation have an impact over the existing models of specialization, so that this latter can heavily change along the growth process and, perhaps, this countries' ability to change can be a fundamental feature for fostering economic growth. If and how specialization, both in static and dynamic sense, influences growth depends on elelments that are both exogenous (nature of spillovers, degree of world integration, etc.) and endogenous ("social capability", institutional framework, etc.)

The effectiveness of the implied mechanisms can have a relation with institutional structures, both at international and national (or regional) level.

We think that empirical works can be useful in highlighting the question, and to identify, if not permanent "rules", at least historical phases of growth and specialization.

2.2 Empirical stuff

On the empirical side, and surprisingly enough, this issue has not been investigated in depth. Some systematic work has been developed only recently, so that it is possible to find only a few indications in this direction, in which structure is considered both in its static and dynamic configuration.

A few works look at the relation between growth and specialization in specific sectors (and areas). As an example, Salavisa (2001) highlights that an industrial structure focused on high-tech sectors is one of the main factors responsible for the rapid economic growth of Ireland. Similarly, the importance of the specialization pattern has also been confirmed by Amable (2000), who shows that countries with comparative advantages in the electronics and ICT sectors achieve greater growth rates. Fagerberg too (1999) reports that specializing in electronics has a positive effect on productivity.

More general works have been recently proposed. Dalum et al.(1999) confirm the theoretical link between specialization and growth. Trade specialization, measured with a Revealed Comparative Advantage (RCA) index, seems to affect the growth rate, but the specialization model apparently does not change over time (Dalum et al.(1996)).

Laursen (1998a) studies the relationship between specialization and growth using a methodology based on structural changes - Constant Market Share (CMS) analysis - which makes it possible to isolate the importance of the initial specialization pattern and of structural changes towards sectors with higher growth rates; he finds evidence that the growth rate of the economy is positively influenced specially by the adaptive effect, which measures the extent to which a country changes its productive structure towards high-growth sectors. This finding would imply that a certain dynamics of the productive structure is necessary for sustained economic growth. Bensidoun et al. [2001] conduct an empirical study of the connection between specialization and growth using a Ricardian approach; as in the previous case, they show that adaptation of the productive structure to world demand is important for explanation of processes of economic growth. A recent study [Worz, 2004] stresses that trade specialization in skill-intensive sectors has a long-term positive effect on economic growth. Worz shows that in the OECD countries both the initial specialization pattern and the capacity to reduce production in low-growth sectors have a positive effect on the growth rate. Finally, very recently, Hausmann, Hwang and Rodrik (2006) formally demonstrate that, in the presence of local "discovery" costs and knowledge spillovers, the mix of goods that a country produces can have important implications for economic growth. They also test this result build up an indirect index of technological (i.e. productivity) level of a country's export basket and show that it predicts subsequent economic growth. The cited empirical papers use different data, measures and empirical strategy to test the linkage between the model of specialization and the rate of economic growth. A summary of methodologies and results can be found in the following synoptic table 1

Like in many fields of economic research, we can observe a high fragmentation of research approaches and results are difficult to compare. Nevertheless, the growth-specialization nexus seem to emerge as a possible relevant feature of international integration. We will try to make some steps further, providing an analysis based on a large dataset and directly comparing results coming out from demand and supply oriented indexes of specialization.

3 Specialization Indexes

3.1 Static indexes

Differently from theoretical works, in empirical ones there is the need to "collapse" an entire distribution (the economic structure, in some kind of statistical representation) into a manageable dimension (the "type" of spe-

Table 1: Previous Works on Specialization-Growth Nexus

author	measures of specialization	data	period	estimator	result
Laursen(1998)	CMS analysis on trade data, results are used in a growth regression	18 OECD countries	1972-1990 3-year-averages	panel data FE RE POOLED fast growing sect. are high-tech	Growth Adaptation Effect, i.e. moving to dynamic sectors, positively related to growth
Dalum, Laursen, Verspagen (1999)	Principal Components analysis on RCA data	20 OECD countries 11 manufac. sectors	3 separate equations for 1965-73,73-79, 79-88	cross-section OLS	Specialization in high tech goods does matter for growth
Busson Villa(1997)	Michaeli Index Trade dissimilarity index Foreign demand growth	57 countries	1967-92	cross section OLS	Inter-industry specialization: negative impact on growth (unless directed towards dyn. sect.)
Bensidoun,Gaulier, Unal-Kesenci	Gsim:Av.pc Gr.rates of countries with similar spec. ADAPT:CTB,Dx/x Intensity of Spec.:st.dev. of CTB	53 countries	1967-1997 5-year-averages	panel data GMM	Some specializations are better than others, especially in dynamic sectors
Hausmann and Rodrik(2006)	EXPY=sum(Xik*PRODYk) Xik=share of country i's prod. of k over all country i's prod. PRODYk: weighted av.of pcGDP of countries exporting k, weight are RCAs ind.	40 countries	1992-2003	cross section OLS IV	What you export matters for growth

cialization). As a consequence, this led authors to do some simplification. We will follow them in this direction, and we will explicitly use some of the proposed index of specialization; we also prefer to focus on comprehensive indexes, that is to say indexes that provide a full, even if synthetic, information on the model of specialization (as an example, we will not employ an index of specialization in a particular sector, like Amable (2000) does with electronics). Moreover we do not follow the line of research proposed by Dalum, Laursen and Verspagen (1999), since their index, obtained through a principal component analysis, does not have a direct interpretation. Bensidoun et al. (2001) build an ad hoc measure that they call GSIM, that is the rate of growth of per capita income of countries with a similar specialization. This is not a measure of specialization: in practice they regress the rate of growth of countries on the rate of growth of similar countries (and, obviously, other variables), expecting a positive relationship between the two[2]. Laursen (1999) algebraically decompose the time change of export in four terms, measuring the market share effects, the structural market effects, the market growth adaptation effect and, finally, the market saturation effect; then they run a regression in which the rate of growth of per capita income is regressed on those four components (and other variables). Also the two previous approaches seem to be too indirect in order to understand the linkage between the nature of specialization and economic growth.

In our opinion it seems be more fruitful the trial of other authors, who try to reduce the distribution of the economic structure (of trade or production) measuring one its significant "content". This direction of analysis also seems more general.

Following indications deriving from the theory of endogenous growth, the first candidate for this "content" is some kind of human capital and/or technology proxy: the general idea is that a structure with a large share of goods with high levels of technology/human capital should foster the rate of growth. Unfortunately, in practice there are not many data relative to technological progress or human capital at the sector level. As a consequence, researchers are forced to measure the level of technology only indirectly contained into the economic structure. Hausmann et al. (2006), following Lall et al. (2005), build a variable measuring the "technological content" of countries' export structure

$$SP_{ha} = \sum_{s=1}^{S} (x_{sc}/X_c) \left[\sum_{c=1}^{C} \frac{x_{sc}/X_c}{\sum_{c=1}^{C} (x_{sc}/X_c)} \times y_c \right] \tag{5}$$

The term in the squared bracket is a weighted sum of per capita GDP (y)

[2]they also use a dynamic index that we will discuss in the next section

of all countries (c), x_{sc} is exports of country c in sector s, X total export of that country. Weights represent a kind of revealed comparative advantage.

In sum, for each product, the content of technology level is calculated averaging per capita income of exporters; then, for each country, it is possible to get the average level of technology of its trade composition [3]. Nevertheless, it should be noted that this implementation of the "quality" of economic structure heavily relies on the idea that most advanced sectors (in technical sense) should necessarily reflect in higher growth. Lall et al. demonstrate that this can be a partially wrong idea and they interpret that measure in a broader sense. While Hausmann et al. take it as a narrow indicator of the technological level, Lall et al. suggest that many factors can be captured by the index: not only technology but also variables depending on marketing, infrastructure, fragmentability, etc.. Furthermore, Lall et al. also show that there is not a strict linkage between growth and their measure.

Table 2: sectoral export "sophistication" and growth rates

sophisitc. level	1990 shares	2000 shares	growth 1990-2000
Level 1	25.5	20.1	4.1
Level 2	21.6	16.2	3.6
Level 3	17.2	19.2	7.8
Level 4	11.9	22.5	13.6
Level 5	9.4	11.9	9.2
Level 6	14.3	10.1	2.9

In table 2 sectors are ranked in groups (level) according to the decreasing content of sophistication (productivity [4]. There is a rough evidence of no or weak correlation between the level of sophistication and the rates of growth of sectors, at least in the nineties. Hausmann et al. get partially different results from panel growth estimations over the period 1992-2003 and 1962-2000: the nature of specialization comes out to be significant in several, but not all of their estimations.

Giving this potential limits, we also develop another measure, more directly connected to export growth, avoiding the passage through the "content" in terms of some other variable. This index, calculated for each country,

[3] In principle technology level could be measured by variables different from y. Since direct technological measures are not easy to find at the sector level, as said before, researchers propose proxies for them. For example, Kaplinsky and Santos Paulino (2003) propose to use trends in export unit values. This procedure has the disadvantage of requiring sufficiently long time series to get time trends through statistical methods. This limits the usefulness of that otherwise potentially interesting method.

[4] In Lall et al. the content of productivity in exports is built similarly to Hausmann et al., but weights are different

Table 3: Comparison of X_{gr} and productivity content

5 products with the lowest	average productivity content	5 products with the lowest X_{gr}	
Copra,-ex.flour and meal-	1650.95	Chassis with engs.for vehic	-0.169
Jute & waste	1430.75	Cigarette paper in bulk etc.	-0.192
Jute fabrics, woven	1589.8	Copra,-ex.flour and meal-	-0.0395
Sisal and other fibres	1440.22	Roasted iron pyrites	-0.0439
Tea	1676.3341	Tannic acids	-0.1266

5 products with the highest	average productivity content	5 products with the highest X_{gr}	
Bacon,ham & other-dried,salted	17795.3	Gas, natural	0.163
Electron and proton accelerators	19164.5	Invalid carriages	0.21
Orthopadic appl.,hearing aids	18680.54	Orthopadic appl.,hearing aids	0.17
Semi-chemical wood pulp	18878.12	Phonograph records,recorded tapes	0.17
Watches, watch movements and cases	18093	Thermionic valves and tubes,etc.	0.17

Source: COMTRADE, PWT 2.6.

is a weighted sum of world sector growth rates, with weights calculated as sector shares in country total exports. Formally

$$SP_{gr} = \sum_{s=1}^{S} (x_{sc}/X_c) \times Xgr_s \tag{6}$$

where Xgr_s is the average yearly rate of growth of world export, between the initial and the final year, for sector s. This index can be thought as more "demand" oriented than the previous one.

In conclusion of this section, we are able to compare, at least broadly speaking, results of the two different theoretical approach, since SP_{ha} can be interpreted more "supply" oriented, while SP_{gr}, as said before, is more "demand" oriented.

In tables 3 and 4 it is possible to take a first impression of the relationships between sectoral export growth rates and productivity content of sectors, and between SP_{gr} and SP_{ha}. Both table give average measures for the whole 1960-2004 period. There are overalps between the right and left part of the tables, but also differences. The picture that emerges is sufficiently clear: products with low (high) level of productivity are similar to products with low (high) growth rates of world demand. Countries with low (high) level of SP_{ha} have something in common (geography or level of development)with countries with low (high) level of SP_{gr} [5].

[5] There is a partial exception for high SP_{gr} countries, where many oil exporting countries are present, probably an effect of the period in analysis.

Table 4: Comparison of SP_{ha} and SP_{gr}

10 countries with the	lowest SP_{ha}	10 countries with the	lowest SP_{gr}
Burki Faso	3214.63	Egypt	0.03
Cameroon	4833.49	Gabon	0.05
Central African Republic	4166.39	Ghana	0.03
Cote d'Ivoire	4163.30	Malawi	0.04
Ghana	3589.41	Nicaragua	0.04
Madagascar	4166.98	Paraguay	0.05
Malawi	3356.51	Senegal	0.04
Sri Lanka	4697.23	Seychelles	0.05
Sudan	3005.76	Sri Lanka	0.05
Togo	3536.23	Sudan	0.03

10 countries with the	highest SP_{ha}	10 countries with the	highest SP_{gr}
Austria	12258.60	Bahrain	0.11
Bahrain	12572.43	Brunei	0.10
Canada	12344.16	Hong Kong	0.11
Finland	12856.02	Ireland	0.11
Japan	12899.14	Israel	0.11
Kuwait	13058.28	Italy	0.10
Sweden	12910.62	Kuwait	0.12
Switzerland	13825.77	Libya	0.12
United Kingdom	12206.27	Malta	0.12
United States	12172.37	Switzerland	0.11

Source: COMTRADE, PWT 2.6.

3.2 Dynamic indexes

As already noted, economic structure usually have a slow change; nonetheless it changes. We should investigate the possibility that the ability in changing trade structure, following demand and/or technological evolution at, could be one of the reasons of economic success (growth) of countries. Along these lines, we propose some indexes whose structure is the time change of the previous static indexes already discussed. The first formulation is

$$DSP_{ha} = \left[\sum_{s=1}^{S}(x_{sc}/X_s)\left(\sum_{c=1}^{C}\frac{x_{sc}/X_c}{\sum_{c=1}^{C}(x_{sc}/X_c)}\times Y_c\right)\right]^{t=1} - \left[\sum_{s=1}^{S}(x_{sc}/X_s)\left(\sum_{c=1}^{C}\frac{x_{sc}/X_c}{\sum_{c=1}^{C}(x_{sc}/X_c)}\times Y_c\right)\right]^{t=0} \quad (7)$$

This formulation compares the content of technology (productivity) of the trade structure of countries at the end and at the beginning of the period in analysis. A positive value means that in the final year the structure has moved to more advanced sectors; these sectors not necessarily are the same in the beginning year.

In the case of equation SP_{gr} the dynamic version is

$$DSP_{gr} = \left[\sum_{s=1}^{S}(x_{sc}/X_c)^{t=n} \times Xgr_s\right] - \left[\sum_{s=1}^{S}(x_{sc}/X_c)^{t=0} \times Xgr_s\right] \qquad (8)$$

In this case, the index of specialization is calculated with weights at the end and at the beginning of the period in analysis, and the index is the difference between the two weighted sums; as a consequence, a positive value would mean a positive change of export structure, since it has shifted toward more dynamic sectors of the world demand, while a negative value would mean the opposite (a shift toward less dynamic sectors). Fast (or slow) growing sectors remain, obviously, unchanged.

4 The empirical model and estimation issues

The empirical model is formulated as a traditional growth regression according to the following specification:

$$\Delta y_{it} = \alpha_0 + \alpha_1 y_{it-\tau} + \beta' X_{it-\tau} + \mu_i + \lambda_t + \epsilon_{it} \qquad (9)$$

and can be re-arranged as

$$y_{it} = \alpha_0 + \delta y_{it-\tau} + \beta' X_{it-\tau} + \mu_i + \lambda_t + \epsilon_{it} \qquad (10)$$

with $\delta = 1 + \alpha_1$ and τ representing the time frequency of the panel.

Here y_{it} is the log of per capita real GDP and $X_{it-\tau}$ represents a set of controls among which the above discussed indexes representing specialization are added to the base specification.

Equation 10 displays a two way error component dynamic panel data model where the lagged dependent variable appears among the right hand side variables. Now, the problem of the correlation between the unobservable heterogeneity and the regressors in general is not a new issue in the empirical growth literature (see Temple(1999), Islam(1995), Knight et al.(1993), Caselli et al.(1996)). The unobservable country specific effects incorporate the countries' different efficiency levels that are likely to be correlated with some of the explanatory variables. This feature makes OLS biased and inconsistent. Anyway this source of inconsistency is hampered by the presence of the lagged dependent variable among the other explanatory variables. Now, any estimator, like Within Group estimator (i.e. OLS on time demeaned data) or First Difference (i.e. OLS on first difference data), that wipes out the fixed effects in general is not enough because part of the inconsistency now comes via the correlation between the lagged dependent variable and the transient shock and this source of correlation stays even after time-demeaning or first-differencing. Nickell (1981) shows that in Within Group estimations the size of the downward bias goes down as long as the panel time span increases. The econometric theory has developed a series of dynamic panel data estimators basically aimed at solving the inconsistency of the previous estimators.

Anderson and Hsiao (1981) suggest to remove the individual heterogeneity first-differencing the original model and to control for endogeneity of the transformed lagged dependent variable, Δy_{it-1}, instrumenting it via the its lagged value, Δy_{it-2}. Arellano (1989) observes that y_{it-2} is the right instrument since it is correlated with Δy_{it-1} and uncorrelated with ϵ_{it} and allows for one more degree of freedom. This estimator is consistent although is not efficient since it does not use all the available orthogonality condition and it does not take into account the structure of the differenced error terms. In this respect, when T, the panel time span, is small and N, the cross section size, is wide, the Arellano and Bond (1991) First Difference GMM estimator provides an improvement in efficiency: all the lagged levels of y_{it-1} are used as instruments for its first difference. This procedure would, then, grant a consistent and efficient estimate of the coefficient on the lagged dependent variable provided that lagged levels are good instruments for first differences. If series are highly persistent, though, this is not the case anymore. For this reason a second GMM estimator was proposed (Arellano and Bover, 1995, Blundell and Bond,1998) were lagged levels of the variables are used as instruments for the first differences and lagged differences are used as instruments for the equation in levels. The so called System GMM represents a useful alternative when the series display a near unit root behavior because it provides a wider and more robust instrument set.

Both GMM estimators rely on the assumption of no first order autocorrelation in the level equation. This results in two tests for AR(1) and AR(2) in the difference equations. If the assumption is satisfied one should reject the AR(1) and fail to reject the AR(2). Finally the Sargan test verifies the validity of the over-identifying restrictions.

The choice here is to estimate the empirical model using OLS, Within Group, First Difference and System GMM in order to compare and test the robustness of our results to alternative estimation techniques. Finally, to overcome the usual endogeneity of the right hand side variables in growth regressions we add the controls in their initial levels.

5 Data set and Methodology

The specialization indicators used in the present work are obtained combining countries trade and income data. The trade data come from the COMTRADE data base and range for a variable number of countries and products from 1962 to 2004. The disaggregation is at the 4 digit SITC revision 1. The use of more disaggregated data was possible although this would have caused the limitation of the analysis to a very short time span thus hampering the chance to analyze long run growth effects of specialization.

The information on countries' income and other macro variables for the specification of the growth empirical model has been recovered by the Penn World Tables (PWT 6.2) containing data on 188 countries between 1960 and 2004. Apart from the variables of interest, further controls were introduced in the estimation of model 10 according to the empirical literature on growth regressions. Proxies for openness, human capital, savings and the population growth rate were introduced in the base specification. Of the original countries present in the data set only those with at least 30 yearly observations were retained, thus remaining with 86 countries.

The data on education were obtained by the Barro and Lee (2000) data set and are made up on five year base information on educational attainment of population aged 15 and 25. Among all the indicators of schooling the ..was chosen.

According to Alcalà and Ciccone, the real openness indicator was calculated as the product between the openness variable and the GDP price level contained in the PWT 6.2.

The population growth rate was calculated on the base of the information contained in the PWT 6.2 as the difference of the log of population.

The PWT provide several measures of constant price PPP real per capita income information for this reason estimates below were repeated using two of these different measures, i.e. the current price real GDP per capita, the real GDP per capita obtained by means of the Laspeyres method and the real GDP per worker.

Since theoretical models always refer to countries' productivity and results were not substantially different across the different income indicators the tables in the appendix bearing the complete set of results concern real GDP per worker although the synthesis of the long run and short run elasticities are shown for both measures. Finally, the robustness of the results has been checked allowing for a greater number of countries in the sample and introducing countries with at least ten yearly observations.

6 Results

Since we have tested our result for 1, 5 and 10 years lag, and for different specification (per capita and per worker income, more or less countries), in the text we show only a representative sample of results, while other results can be found in the appendix tables. In tables of this section we will show only significant parameters for the 5 years lag estimation, both for the static and the dynamic indexes of specialization and with countries with at least 30 observations (small sample). Each table shows the four different estimators adopted, i.e. OLS, Within Group, FD-GMM and System GMM. The last lines in each table respectively show the number of countries in the sample, the Sargan test and the Arellano and Bond test for AR(2) in the differences, i.e. for first order serial correlation in levels.

Table 5: Results-SP_{ha} 5-year-lags

COEFFICIENT	(1) OLS	(2) FE	(3) FD-GMM	(4) SYS-GMM
lrgdpwok_5	0.935***	0.749***	0.482***	0.906***
	(0.011)	(0.035)	(0.12)	(0.019)
inv._5	0.0759***	0.0232	-0.113***	0.0806***
	(0.014)	(0.027)	(0.039)	(0.029)
openness_5	0.0146	0.0157	0.00245	0.0299*
	(0.0091)	(0.020)	(0.052)	(0.016)
pop.gr.	-0.484***	-0.0980	0.438	-0.669***
	(0.12)	(0.20)	(0.39)	(0.19)
SP_{ha}_5	0.0560**	0.0574**	0.0633	0.119**
	(0.025)	(0.028)	(0.038)	(0.049)
Observations	2555	2555	2380	2555
Number of countries			83	83
Sargan			1	1
AR2			0.180	0.341

Robust standard errors in parentheses
*** p¡0.01, ** p¡0.05, * p¡0.1
Year dummies

In tables 5 and 6, the coefficients for the lagged dependent variable investment and the rate of growth of population are in most cases significant and with the right sign, and, in any case, they are in the SYS GMM estimation; the openness coefficient results significant (and of the right sign) only in the SYS GMM. Education is dropped away from the table since its coefficient is never significant. As for regards specialization indexes, it is possible to appreciate that both static indexes come out to be positive and significant in system GMM estimations (as in OLS and WG). As suspected the high

Table 6: Results-SP_{gr} 5-year-lags

COEFFICIENT	(1) OLS	(2) FE	(3) FD-GMM	(4) SYS-GMM
lrgdpwok_5	0.951***	0.768***	0.510***	0.940***
	(0.0084)	(0.034)	(0.13)	(0.011)
inv._5	0.0794***	0.0274	-0.114***	0.0887***
	(0.013)	(0.026)	(0.043)	(0.026)
openness_5	0.0133	0.00871	-0.0182	0.0314**
	(0.0093)	(0.020)	(0.056)	(0.015)
pop.gr.	-0.552***	-0.151	0.484	-0.777***
	(0.11)	(0.20)	(0.44)	(0.17)
SP_{gr}_5	0.0875***	0.0731***	0.0134	0.0780***
	(0.028)	(0.026)	(0.012)	(0.025)
Observations	2576	2576	2407	2576
Number of countries			83	83
Sargan			1	1
AR2			0.154	0.317

Robust standard errors in parentheses
*** p¡0.01, ** p¡0.05, * p¡0.1
Year dummies

persistence in the series causes the FD GMM estimator of y_{it-1} to be heavily downward biased, especially when five and ten year lags are considered . The rule of thumb for weak instruments suggests that the FD GMM estimate of the autoregressive component should lie between the Within Group (lower bound) and the OLS (upper bound) estimates. The use of further instruments in the System GMM causes the estimate to satisfy this requirement both in its point estimate and in its confidence interval. The results emerging from the System GMM in the last column of each table are then our preferred. At this stage of the analysis we are not in the position of preferring $SPha$ or $SPgr$.

The following tables 7-8 have a structure similar to the previous ones, but they report results for the dynamic version of the indexes.

Contrary to our a priori expectations, parameters for these indexes are not significant, moreover they have the right signs only in the DSP_{gr} case. Our interpretation of this result has to do with sloweness of sectoral structure change; in panel estimations our initial static indexes change each 5 years (or at 1 or 10 intervals in other estimations), probably capturing some of the dynamic component. Besides, dynamic indexes only measures the average change in the structure inside those time intervals (1, 5, 10 years), and we suppose that they represent a too short period for a inerently sluggish phenomena.

Table 7: Results-DSP_{ha} 5-year-lags

COEFFICIENT	(1) OLS	(2) FE	(3) FD-GMM	(4) SYS-GMM
lrgdpwok_5	0.954***	0.768***	0.489***	0.957***
	(0.0098)	(0.038)	(0.13)	(0.013)
inv._5	0.0798***	0.0289	-0.0965**	0.0811***
	(0.014)	(0.027)	(0.037)	(0.023)
openness_5	0.0133	0.0207	0.0190	0.0374**
	(0.0096)	(0.020)	(0.044)	(0.016)
pop.gr.	-0.479***	-0.112	0.480	-0.461**
	(0.13)	(0.20)	(0.43)	(0.18)
DSP_{ha}	-0.000261	-0.000762	-0.000171	0.000460
	(0.0011)	(0.0010)	(0.00079)	(0.0011)
Observations	2397	2397	2281	2397
R^2	0.98	0.99	.	.
Number of newcode			83	83
Sargan			1	1
AR2			0.187	0.356

Robust standard errors in parentheses
*** p¡0.01, ** p¡0.05, * p¡0.1
Year dummies

Table 8: Results-DSP_{gr} 5-year-lags

COEFFICIENT	(1) OLS	(2) FE	(3) FD-GMM	(4) SYS-GMM
lrgdpwok_5	0.952***	0.770***	0.506***	0.942***
	(0.0085)	(0.034)	(0.13)	(0.014)
inv._5	0.0791***	0.0261	-0.113***	0.0945***
	(0.014)	(0.026)	(0.042)	(0.028)
openness_5	0.0138	0.00906	-0.0191	0.0307**
	(0.0094)	(0.020)	(0.059)	(0.015)
pop.gr.	-0.561***	-0.151	0.457	-0.686***
	(0.11)	(0.20)	(0.42)	(0.16)
DSP_{gr}	0.00163	0.000857	0.000484	0.00111
	(0.0012)	(0.00097)	(0.00067)	(0.0011)
Observations	2576	2576	2407	2576
Number of countries			83	83
Sargan			1	1
AR2			0.156	0.324

Robust standard errors in parentheses
*** p¡0.01, ** p¡0.05, * p¡0.1
Year dummies

In the appendix we show the results when yearly panel and ten years observations are considered. Results generally confirm, with very small differences, the described results for the 5 year lags estimation. This holds both for the static and the dynamic indexes.

Finally table 9 summarizes the previous results showing the long run elasticities of our specialization indicators. In the long run only the SP_{ha} seems to significantly affect the steady state level of GDP per worker/capita.

Table 9: Results- Long run Elasticities

	1-year lags		5-year lags		10-year lags	
real gdp	per work.					
SP_{ha}	0.909	*	1.264	***	0.715	*
SP_{gr}	0.168	*	0.106	**	0.016	
DSP_{ha}	0.071	**	0.000		0.000	
DSP_{gr}	-0.014		0.002		0.000	
real gdp	per capita					
SP_{ha}	0.845		1.275	***	0.721	
SP_{gr}	0.185		0.113	**	0.016	
DSP_{ha}	0.084		0.000		0.000	
DSP_{gr}	-0.014		0.001		0.000	
real gdp	per work.	all	sample			
SP_{ha}	0.899	*	1.321	***	0.94	**
SP_{gr}	0.164	*	0.085	**	0.01	
DSP_{ha}	0.041	*	0.000		0.00	
DSP_{gr}	-0.016		0.002		0.00	
real gdp	per capita	all	sample			
SP_{ha}	0.96	*	1.28	***	1.02	**
SP_{gr}	0.21		0.05	*	-0.03	
DSP_{ha}	0.04		0.00		0.00	
DSP_{gr}	-0.02		0.00		0.00	

Table 10 shows the long run elasticities when the observations after 1980 are considered. The pace of openness increases after 1980 and some developing countries also start becoming active players in global trade: the idea is that if specialization plays a role in countries long run growth it is more likely to emerge after that date. The upper part of the table shows the results for all the countries present at least ten times in the period under analysis and the lower panel shows the results for all the countries present in the sample from 1980 to 2004. The table also conveys information on the estimation of the empirical model for two rough sub-groups of countries, the High Income (HI) group and the Low Income (LI) group. The results from the table substantially confirm the previous findings with the static indexes dominating the dynamic ones when longer period panels are considered. As far as the heterogeneous effect of specialization on country groups is concerned, HI countries log run growth especially benefits from being specialized in high productivity content goods. For this group of countries, the dynamic version of the SP_{gr} index is also slightly significant although its contribution to the steady state gdp per worker is very small. The dynamic version of the Hausmann and Rodrik' index, DSP_{gr} is particularly related to growth when the one year periodicity of the panel is concerned and lose relevance when longer periods are taken into account. When splitting the sample into HI and LI countries the significance of the coefficient for this index stays for both groups although the significance decreases for the latter group when all the countries present from 1980 onwards are considered in the sample: to catch the effect of a changing export structure it is important to follow the phenomenon across countries and especially across time and allowing for countries with a few year observations could dilute the result obtained with at least ten presences in the sample.

Table 10: Results- Long run Elasticities after 1980

	1-year lags		5-year lags		10-year lags	
real gdp	per work.					
SP_{ha}	0.357		1.101	**	1.675	***
SP_{gr}	0.077		0.036	**	0.040	*
DSP_{ha}	0.035	**	0.002		0.000	
DSP_{gr}	-0.006		0.001		0.001	
High Income						
SP_{ha}	0.10		0.64	*	0.86	***
SP_{gr}	0.11	***	0.04	***	0.02	
DSP_{ha}	0.02	***	0.00		0.00	
DSP_{gr}	0.00		0.00		0.00	*
Low Income						
SP_{ha}	-0.467		0.763		0.958	*
SP_{gr}	0.047		0.022	*	0.020	*
DSP_{ha}	0.036	**	0.001		0.000	
DSP_{gr}	-0.008		0.000		0.000	
real gdp	per work.	all	sample			
SP_{ha}	0.357		1.101	**	1.675	***
SP_{gr}	0.077		0.036	**	0.040	*
DSP_{ha}	0.035	**	0.002		0.000	
DSP_{gr}	-0.006		0.001		0.001	
High Income						
SP_{ha}	0.139		0.638	*	0.863	***
SP_{gr}	0.125	*	0.044	***	0.015	
DSP_{ha}	0.018	***	0.000		0.000	
DSP_{gr}	-0.004		0.001		0.000	*
Low Income						
SP_{ha}	0.34		0.40		0.95	*
SP_{gr}	0.06	*	0.02	*	0.02	*
DSP_{ha}	0.03	*	0.00		0.00	
DSP_{gr}	-0.01		0.00		0.00	

7 Preliminary Conclusions

At this stage of our work, we have simple but neat enough results. Introducing different indexes of qualitative specialization into an usual framework for an empirical investigation of economic growth determinants, we are able to say something about the role that specific sectors may play in influencing the path of economic growth.

We started recognizing that at least two theoretical traditions give indications that we should expect not flexible model of specialization, stable growth rates but different among different countries. We also recognized that the presence of spillovers, at sectoral and regional level, may substantially change this simple picture, as demonstrated by more rich theoretical models.

Our empirical results confirm that specializing in some sectors instead than others may have an impact on the rate of economic growth of an economy. The model of specialization is relevant.

This kind of result seem robust enough to different specifications: different indexes, different time lags, different country panels. Nevertheless, we expected that the country capacity to adapt at a changing world should have played a positive role. Instead this is not the case: our dynamic indexes do not seem significant. So the message of this paper, for policy purposes, should be that a country should pay much attention because the international integration process could condition its specialization in the wrong way, at least for its rate of economic growth. We would like to deeepen this results in our future researches: it is possible that our choices in the econometric strategy have partially determined the final outcome.

8 References

Amable B. (2000), "International specialization and growth", *Structural Change and Economic Dynamics*, n. 11, pp. 413-431

Bender S., Kui-Wai Li (2002),"the Changing Trade and Revealed Comparative Advantages of Asian and Latin American Manufacture Exports ", *Economic Growth Center Discussion Papers, Yale University*, n. 843 March

Bensidoun I., Gaulier G., Unal-Kesenci D. (2001), "The nature of specialization matters for growth: an empirical investigation", *CEPII WP*, n.13 Dicember

Dalum B., Laursen K., Verspagen B.(1999), "Does specialization matter for growth?", *industrial and Corporate change*, 8(2), pp. 267-288

Fiorillo F.(2001), "Rate of growth and sector specialization coevolution in a Kaldorian export-led growth model", *Structural Change and Economic Dynamics*, 12, pp. 91-114

Grossman G.M., Helpman E. (1991),"Innovation and Growth in the Global Economy ", *MIT press*

Hausmann R., Hwang J., Rodrik D. (2006), "What you Export Matters", *unpuplished, Harvard University*

Kaplinsky R., Santos Paulino A. 2003, "Innovation and competitiveness: trends in unit prices in global trade,", *Freeman Centre, University Sussex,* November

Krugman P.(1989), "Differences in income elasticities and trends in real exchange rates", *European Economic Review*, 33, pp. 1031-1054

Lall S., Weiss J., Zhang J. (2005), "The "Sofistication" of Exports: A new Measure Of Product Characteristics", *Queen Elizabeth House Working Paper Series*, n. 123

Laursen K. (1998), "How Structural Change Differs, and Why it Matters (for Economic Growth)", *Druid Working Paper* n. 98-25

Los B., Verspagen B. (2006), "The Evolution of Productivity Gaps and the Specialization Patterns", *Metroeconomica*, 57:4, pp. 464-493

Lucas R. (1988), "On the mechanics of Economic Development", *Journal of Economic Development*, 22, pp. 3-42

McCombie J.S.L., Thirlwall A.P (1994), "Economic Growth and the Balance-of-Payments Constraint", *St. Martin Press*

Salavisa(2000),"Growth, Innovation and Specialization Patterns - History and Institutions in Intermediate Countries", *Mimeo. DINAMIA, Ed. ISCTE.*

Worz J. (2004), "Skill intensity in foreign trade and economic growth", *Tinbergen institute Discussion Paper*, 04-059/2

9 appendix

Figure 1: Real GDP per worker and Specialization indexes

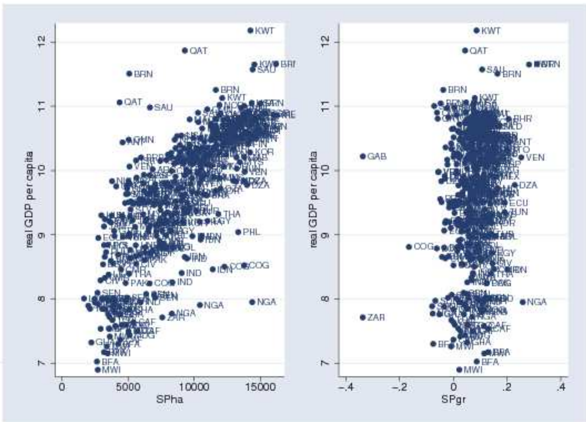

Table 11: Descriptive statistics

Variable		Mean	Std. Dev.	Min	Max	Observations	
real gdp per capita	overall	8.77	1.03	5.75	11.35	N	3174
laspeyres method	between		1.03	6.52	10.59	n	84
	within		0.30	7.46	9.94	T-bar	37.79
real gdp per worker	overall	9.65	1.01	6.55	12.19	N	3094
	between		1.03	7.22	11.34	n	83
	within		0.27	8.52	10.60	T-bar	37.28
real gdp per capita growth	overall	0.02	0.05	-0.77	0.77	N	3024
laspeyres method	between		0.02	-0.03	0.06	n	84
	within		0.05	-0.78	0.76	T-bar	36
real gdp per worker growth	overall	0.01	0.05	-0.75	0.73	N	2945
	between		0.02	-0.06	0.05	n	83
	within		0.05	-0.76	0.73	T-bar	35.48
inv.	overall	2.70	0.58	-1.66	4.24	N	3049
	between		0.52	1.15	3.76	n	84
	within		0.28	-1.08	4.62	T-bar	36.30
pop.gr.	overall	0.02	0.02	-0.81	0.40	N	3155
	between		0.01	0.00	0.06	n	86
	within		0.02	-0.82	0.38	T-bar	36.69
open.	overall	8.03	0.86	5.11	11.05	N	3049
	between		0.74	6.27	9.60	n	84
	within		0.44	5.78	10.01	T-bar	36.30
SP_{ha}	overall	8618.85	3849.67	0.00	22609.46	N	3155
	between		2872.81	2954.50	13726.61	n	86
	within		2634.79	-1883.87	21974.82	T-bar	36.69
SP_{gr}	overall	0.08	0.15	-0.78	1.45	N	3314
	between		0.02	0.03	0.12	n	86
	within		0.14	-0.79	1.41	T-bar	38.53
DSP_{ha}	overall	127.61	1602.33	-22609.46	18267.57	N	3155
	between		163.07	-663.19	492.41	n	86
	within		1595.59	-21818.66	19058.37	T-bar	36.69

Table 12: Pairwise correlations

real gdp per capita growth	1.00								
real gdp per worker growth	0.9899*	1.00							
inv.	0.2015*	0.1856*	1.00						
pop.gr.	-0.1524*	-0.1794*	-0.2134*	1.00					
open	0.01	-0.02	0.2283*	-0.03	1.00				
SP_{ha}	-0.03	-0.0698*	0.3089*	-0.2211*	0.3941*	1.00			
SP_{gr}	0.1411*	0.1454*	0.03	-0.01	0.00	0.0366*	1.00		
DSP_{gr}	-0.01	-0.01	-0.01	0.03	-0.0946*	-0.0882*	-0.02	1.00	
DSP_{ha}	0.1323*	0.1411*	0.0404*	0.00	-0.02	-0.2329*	0.0564*	0.087*	1

* -significant at 5%.

Table 13: Results-SP_{ha}

COEFFICIENT	(1) OLS	(2) FE	(3) FD-GMM	(4) SYS-GMM
lrgdpwok_1	0.989***	0.960***	0.807***	0.980***
	(0.0025)	(0.0089)	(0.085)	(0.0069)
inv._1	0.0176***	0.0125**	-0.0146	0.0320***
	(0.0031)	(0.0053)	(0.023)	(0.0059)
openness_1	0.00247	0.00370	0.0279	0.00617
	(0.0017)	(0.0038)	(0.019)	(0.0064)
pop.gr.	-0.435***	-0.379***	-0.210	-0.411***
	(0.038)	(0.044)	(0.23)	(0.035)
SP_{ha}_1	0.00878	0.0101	0.00194	0.0186
	(0.0053)	(0.0077)	(0.022)	(0.013)
Observations	2921	2921	2775	2921
Number of countries			83	83
Sargan			1	1
AR2			0.507	0.522

Robust standard errors in parentheses
*** p¡0.01, ** p¡0.05, * p¡0.1
Year dummies

Table 14: Results-SP_{gr}

COEFFICIENT	(1) OLS	(2) FE	(3) FD-GMM	(4) SYS-GMM
lrgdpwok_1	0.991***	0.964***	0.852***	0.988***
	(0.0017)	(0.0079)	(0.080)	(0.0041)
inv._1	0.0183***	0.0126**	-0.0145	0.0295***
	(0.0031)	(0.0052)	(0.021)	(0.0057)
openness_1	0.00221	0.00313	0.0297*	0.00762
	(0.0017)	(0.0037)	(0.018)	(0.0062)
pop.gr.	-0.458***	-0.388***	-0.217	-0.442***
	(0.045)	(0.041)	(0.28)	(0.054)
SP_{gr}	0.0334***	0.0295***	0.0152	0.0267**
	(0.011)	(0.011)	(0.013)	(0.012)
Observations	2945	2945	2809	2945
Number of countries			83	83
Sargan			1	1
AR2			0.506	0.518

Robust standard errors in parentheses
*** p¡0.01, ** p¡0.05, * p¡0.1
Year dummies

Table 15: Results-DSP_{ha}

COEFFICIENT	(1) OLS	(2) FE	(3) FD-GMM	(4) SYS-GMM
lrgdpwok_1	0.992***	0.965***	0.806***	0.989***
	(0.0018)	(0.0085)	(0.098)	(0.0051)
inv._1	0.0179***	0.0132**	-0.0129	0.0294***
	(0.0030)	(0.0051)	(0.024)	(0.0054)
openness_1	0.00238	0.00359	0.0230	0.00750
	(0.0018)	(0.0040)	(0.017)	(0.0058)
pop.gr.	-0.428***	-0.370***	-0.197	-0.394***
	(0.036)	(0.046)	(0.31)	(0.030)
DSP_{ha}	0.0616***	0.0568***	0.0397***	0.0531***
	(0.012)	(0.011)	(0.013)	(0.012)
Observations	2908	2908	2766	2908
Number of countries			83	83
Sargan			1	1
AR2			0.493	0.506

Robust standard errors in parentheses
*** p¡0.01, ** p¡0.05, * p¡0.1
Year dummies

Table 16: Results-DSP_{gr}

COEFFICIENT	(1) OLS	(2) FE	(3) FD-GMM	(4) SYS-GMM
lrgdpwok_1	0.991***	0.964***	0.861***	0.985***
	(0.0018)	(0.0079)	(0.081)	(0.0052)
inv._1	0.0182***	0.0120**	-0.0149	0.0308***
	(0.0031)	(0.0052)	(0.021)	(0.0057)
openness_1	0.00224	0.00300	0.0293	0.00559
	(0.0018)	(0.0038)	(0.018)	(0.0062)
pop.gr.	-0.464***	-0.390***	-0.417*	-0.436***
	(0.047)	(0.039)	(0.21)	(0.046)
DSP_{gr}	-0.0118	-0.00602	0.00528	-0.0137
	(0.022)	(0.022)	(0.021)	(0.021)
Observations	2945	2945	2809	2945
Number of countries			83	83
Sargan			1	1
AR2			0.517	0.518

Robust standard errors in parentheses
*** p¡0.01, ** p¡0.05, * p¡0.1
Year dummies

Table 17: Results-SP_{ha} 10-year-lags

COEFFICIENT	(1) OLS	(2) FE	(3) FD-GMM	(4) SYS-GMM
lrgdpwok_10	0.892***	0.544***	0.454***	0.851***
	(0.023)	(0.060)	(0.13)	(0.030)
inv._10	0.144***	0.0122	-0.0406	0.128***
	(0.022)	(0.031)	(0.027)	(0.039)
openness_10	0.0267	0.0495	-0.0132	0.0394*
	(0.018)	(0.035)	(0.067)	(0.022)
d10lpop	-0.565***	-0.306	0.306	-0.869***
	(0.13)	(0.25)	(0.44)	(0.15)
SP_{ha}_10	0.0300	-0.00429	-0.00322	0.107
	(0.050)	(0.054)	(0.056)	(0.076)
Observations	2166	2166	2006	2166
Number of countries			82	83
Sargan			1.000	1
AR2			0.127	0.625

Robust standard errors in parentheses
*** p¡0.01, ** p¡0.05, * p¡0.1
Year dummies

Table 18: Results-SP_{gr} 10-year-lags

COEFFICIENT	(1) OLS	(2) FE	(3) FD-GMM	(4) SYS-GMM
lrgdpwok_10	0.899***	0.539***	0.358***	0.883***
	(0.016)	(0.060)	(0.12)	(0.019)
inv._10	0.146***	0.0113	-0.0552*	0.139***
	(0.022)	(0.030)	(0.031)	(0.037)
openness_10	0.0269	0.0496	-0.0180	0.0517**
	(0.018)	(0.035)	(0.062)	(0.023)
d10lpop	-0.591***	-0.353	0.406	-0.964***
	(0.13)	(0.24)	(0.48)	(0.15)
SP_{gr}_10	0.0819*	0.0529*	-0.0330*	0.0224
	(0.045)	(0.027)	(0.017)	(0.035)
Observations	2185	2185	2030	2185
Number of countries			82	83
Sargan			1.000	1
AR2			0.118	0.697

Robust standard errors in parentheses
*** p¡0.01, ** p¡0.05, * p¡0.1
Year dummies

Table 19: Results-DSP_{ha} 10-year-lags

COEFFICIENT	(1) OLS	(2) FE	(3) FD-GMM	(4) SYS-GMM
lrgdpwok_10	0.897***	0.527***	0.292**	0.896***
	(0.019)	(0.069)	(0.14)	(0.024)
inv._10	0.148***	0.0271	-0.128***	0.159***
	(0.024)	(0.038)	(0.043)	(0.030)
openness_10	0.0270	0.0719*	0.0549	0.0667***
	(0.018)	(0.040)	(0.047)	(0.023)
d10lpop	-0.448***	-0.161	0.802	-0.555***
	(0.15)	(0.34)	(0.68)	(0.20)
DSP_{ha}	0.0000444	0.0000889*	0.0000969***	0.0000360
	(0.000065)	(0.000050)	(0.000037)	(0.000066)
Observations	1891	1891	1803	1891
Number of countries			77	79
Sargan			1	1
AR2			0.0435	0.185

Robust standard errors in parentheses
*** p¡0.01, ** p¡0.05, * p¡0.1
Year dummies

Table 20: Results-DSP_{gr} 10-year-lags

COEFFICIENT	(1) OLS	(2) FE	(3) FD-GMM	(4) SYS-GMM
lrgdpwok_10	0.900***	0.542***	0.366***	0.887***
	(0.016)	(0.060)	(0.12)	(0.024)
inv._10	0.146***	0.0104	-0.0518*	0.146***
	(0.022)	(0.030)	(0.031)	(0.040)
openness_10	0.0275	0.0501	-0.0105	0.0618***
	(0.018)	(0.035)	(0.062)	(0.022)
d10lpop	-0.596***	-0.350	0.326	-0.963***
	(0.13)	(0.24)	(0.43)	(0.14)
DSP_{gr}	-0.0000545	-0.0000679	-0.0000380	-0.0000958
	(0.000075)	(0.000066)	(0.000039)	(0.000081)
Observations	2185	2185	2030	2185
Number of countries			82	83
Sargan			1.000	1
AR2			0.131	0.702

Robust standard errors in parentheses
*** p¡0.01, ** p¡0.05, * p¡0.1
Year dummies